REQUEST FOR IRAC/SPECTRUM PLANNING SUBCOMMITTEE REVIEW for Stage 3 Frequency Assignment for Telecommunication Systems Intended to Provide Radiolocation Service for Wind and Temperature Profiling in the 890-942 MHz band for the Federal Government

INTRODUCTION:

The Federal Government initiated a wind Profiler radar program in 1981 to experiment with and perfect lower atmosphere wind profiling. The initial frequency request for one of three frequency domains for anticipated weather-related wind Profiler research was in the UHF range at 890-942 MHz. The frequency range assigned in response to a Stage 2 request was at 915 MHz in the ISM band.

Extensive research experience with both fixed and many portable 915 MHz wind Profilers, along with more recent temperature profiling, deriving temperature from the velocity of an acoustic signal, now warrants assignment of spectrum support at Stage 3 for developmental testing of proposed operational hardware and potential equipment configurations.

Temperature profiling critical to meteorological applications in the lower atmosphere using a Radio Acoustic Sounding System (RASS) has a greater height range if the wind Profiler operates at frequencies lower than 400 MHz. However, for the purpose of this Stage 3 request, which will ultimately lead to a Stage 4 request for government operational wind and temperature profiling, frequency assignment at 915 MHz is proposed. The unique, upwards propagation pattern of the UHF wind Profiler warrants this accomodation with present government and non-government allocations to other ground-based users.

BASIS FOR REQUEST:

On July 17, 1979 the IRAC/SPS approved the experimental wind

There are a multitude of single source potential problems, such as nuclear power plants, where small networks of lower atmosphere wind Profilers could monitor winds in order to provide optimum winds information for public safety purposes should inadvertent release of radioactive emissions occur.

In February 1991 a Cooperative Research and Development Agreement (CRDA) was signed by NOAA and two private sector firms, the Radian Corporation and Sonoma Technology Incorporated, for the transfer of technology and proprietary information required by the firms to design and build wind and temperature profilers for the world market. This CRDA addresses a growing government and private sector need for high resolution lower atmosphere winds and temperature remote sensing systems.

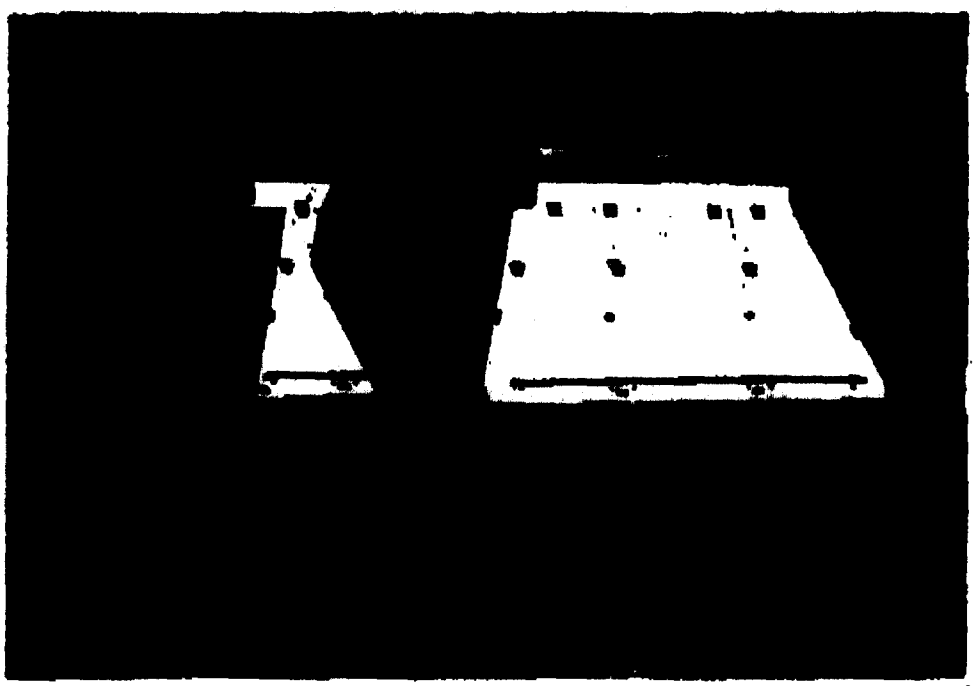
The addition of RASS to the wind Profiler has already proven the increased value of frequent, high resolution temperature profiles. It will be argued that with increased system power and antenna aperture the UHF Profiler/RASS temperature systems will find a broad market, both for the government and private sector with the latter potentially driven by commercial TV broadcast sources eager to capitalize on the dramatic graphics tailored for public consumption and understanding in the era of twenty-four hour newscasts.

Improved UHF systems now being developed at 915 MHz will begin to reach heights of 6 to 7 km above ground, clearly a height of interest to mesoscale numerical modelers. The potential for improved short term mesoscale forecasting appears promising with anticipated wide usage by both government and private sector applications of UHF Profiler technology for meteorological purposes for nation-wide applications.

The response to this Stage 3 request will be an important indicator for an eventual application by the CRDA private sector principals for a commercial operational frequency for UHF wind Profilers with an estimated system cost in the range $100-110 thousand.

SUMMARY AND RECOMMENDATION:

A frequency use analysis conducted by the Department of Commerce representative to IRAC in 1990 determined that the least used part of the ISM band were the seven MHz centered on 915 MHz. Wind Profiler operations at 915 MHz over the past ten years have demonstrated compatibility in this band with all other users there.



Revised 5/89

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Agency No. _____

TRANSMITTER EQUIPMENT CHARACTERISTICS

1. Nomenclature/Model No. Boundary Layer Profiler Transmitter	2. Manufacturer's Name Lab Built
3. System Nomenclature	4. Transmitter Type pulsed Doppler
5. Tuning Range 915 MHz	6. Method of Tuning fixed
8. RF Channeling Capability	7. Frequency Stability + 10 ppm
8. Emission Designator(s) 12M5OPON	9. Emission Bandwidth for 400 ns pulse ☐ Calculated ☒ Measured -3dB 2.5 MHz -20 dB 2.5 MHz -40 dB 80 MHz -60 dB 900 MHz Occupied Bandwidth _____ (BOD)
10. Filter employed ☐ Low Pass ☐ High Pass ☐ Band Pass ☒ None	
11. Maximum Bit Rate	12. Maximum Modulating Frequency
13. Pre Emphasis ☐ Yes ☒ No	14. Deviation Ratio
15. Power (a) Carrier _____ (b) Mean _____ (c) Peak Envelope 500 watts	16. Pulse Characteristics (a) Rate 40,000 - 10,000 pps (b) Width 400 - 2800 ns (c) Rise time 50 ns (d) Fall time 25 ns (e) Compression Ratio 2,4,8,10,16
17. Output Device solid state	
18. Spurious Level <-30 db	19. Harmonic Level (a) 2nd -20 db (b) 3rd <-30 db (c) Other <-30 db
20. FCC Type Acceptance No.	

21. Remarks

9. Emission measured for 400 ns pulse width.
16. a) Inter-pulse period is selectable from 25 ns up in 5 ns increments but 25, 50, & 100 microseconds are commonly used.
b)One of four pulse widths is selectable. Current available pulse widths are 400, 700, 1400, & 2800 ns.
c)Pulse compression is not currently used, but is planned for future implementation. Code length is selectable.
19. Below instrumental sensitivity of 30 dB.

Form NTIA-35

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NTIA 35

ANTENNA EQUIPMENT CHARACTERISTICS

1. Nomenclature Model Number Boundary Layer Profiler Antenna	1a. Manufacturer's Name Lab Built
2. System Nomenclature	3. Type microstrip phased array 1 x 3 meters
4. Frequency Range 10 MHz	5. Polarization vertical
6. Gain (a) Main Beam 26 dBi (b) Side Lobe -13 dB down from main beam @ 15°	7. Scan Characteristics (a) Type fixed pointing angles (b) Vertical Scan (1) Max. Elev. ______ (2) Min. Elev. ______ (3) Scan Rate ______ (c) Horizontal Scan (1) Sector Scanned ______ (2) Scan rate ______
8. Beamwidth (a) Horizontal 20° (b) Vertical 6°	

9. Remarks

3. Three separate antennas are used for wind profiling. Two antennas pointing 15 deg. from the vertical aimed in orthogonal azimuths & one pointing vertically. Antennas are built from 1 meter square panels into various configurations. The orthogonal antennas currently in use are 3 x 1 meters giving a 6 x 20 deg. beamwidth. The vertical antenna is either 1 x 2 meters for a 20 x 10 deg. beamwidth or 2 x 2 meters resulting in a 10 x 10 deg. beamwidth. An electrically steerable phased array is used on some systems that is 3 x 3 meters with a circular beamwidth of 6 deg.

6. Gain & side lobe levels are given for a 2 x 2 meter antenna. Ground clutter fences are used to block any side lobe energy to 20 deg. above the horizon.

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NTIA-84

U.S. DEPARTMENT OF COMMERCE

RECEIVER EQUIPMENT CHARACTERISTICS

1. Nomenclature/Model Number: Boundary Layer Profiler Receiver	1a. Manufacturer's Name: lab built
2. System Nomenclature	2. Receiver Type: Heterodyne
4. Tuning Range: 915 MHz	5. Method of Tuning: fixed
6. RF Channeling Capability	7. Frequency Stability: + 10 ppm
8. Emission Designator(s): 12M50PON	9. RF Selectivity: (a) Calculated ☐ Measured ☐ (b) -3 dB: 33 MHz; (c) -20 dB: 40 MHz; (d) -40 dB: 60 MHz; (e) Type of preselection used: none
10. IF Selectivity: (a) -3 dB: 10 MHz; (b) -20 dB: 27 MHz; (c) -60 dB: 42 MHz	
11. Maximum Bit Rate: N/A	12. Minimum Post Detection Frequency: 2.5 MHz
13. De-emphasis Available: ☐ Yes ☐ No	14. Maximum Post Detection Frequency: .33 MHz
15. IF Frequency: 60 MHz	16. Sensitivity: (a) -140 dB m dBw; (b) Criteria: -15 db SNR; (c) Noise Temperature Noise Figure: 2 db Kelvin dB
17. Oscillator Tuned: Above tuned frequency ☐; Below tuned frequency ☒; Either above or below tuned frequency ☐	
18. Spurious Rejection: 45 dB	19. Image Rejection: 45 db

20. Remarks

12. Post detection bandwidth is selectable for four pulse widths. The maximum post detection frequency is determined by the matched filter for the 400 ns pulse width.

14. The minimum post detection frequency is determined by the matched filter for the 2.8 micro sec pulse width.

[redacted]

November 19, 1992

Ref. SPS-9141/2

MEMORANDUM

TO: Richard Barth
Department of Commerce SPS Representative

FROM: Michael Richmond
Systems Review Branch

SUBJECT: Data Submitted for 915 MHz Boundary Layer Profiler, Stage 3.

After an initial review of SPS-9141/2, the following data adequacy problems were found. Please verify accuracy of conflicting data and supply missing data if available.

1) On page 2 of the attachment, portable wind profilers are discussed. I believe these profilers are transportable (not intended to be used while in motion). Portable equipment can be used while in motion or during brief halts at unspecified locations. Will this system be transportable?

2) What is area of operation? USAP?

3) The necessary bandwidth stated on the 4th page of the attachment is 4 MHz. The transmitter page shows it to be 12.5 MHz. The 12.5 MHz bandwidth appears correct based on the available data.

4) The emission bandwith provided is for the 400 ns pulse width only. Is there emission bandwidth data for the other pulse widths? If the necessary bandwidths are different for the pulse widths, then they should be supplied.

5) How do the pulse widths correspond to the pulse rates?

6) The pulse widths appear to range from 5 ns to 100 us as shown in the transmitter remarks.

7) The transmitter remarks regarding the harmonic and spurious levels state "Below instrumental sensitivity of 30 dB." However, the emission bandwidth is "measured" down to -50 dB. Please verify this.

25 Nov. 1992

To: Richard Barth

From: Jim Jordan

Subject: Reply to initial review of SPS-9141/3

Here is the reply to your FAX of Nov. 24.

1. The wind profilers are not intended to be used in motion.

2. The area of operation is U.S. and Puerto Rico.

3. I don't have a copy of what was sent in, but the necessary bandwidth should be 12.5 MHz in both places.

4. The necessary bandwidth for all the pulse widths are:

400 nsec pulse	12.5 MHz
700 nsec pulse	9.6 MHz
1400 nsec pulse	6.8 MHz
2800 nsec pulse	4.8 MHz

5. The pulse rate and pulse width are independently selectable. Due to range aliasing considerations, 25 μsec, 50 μsec, and 100 μsec are most commonly used.

6. Part a of the transmitter remarks states that the Inter-pulse period is selectable from 25 nsec in 5 nsec increments. Part b of the remarks states that the pulse widths available are 400 nsec, 700 nsec, 1400 nsec, and 2800 nsec.

7. The harmonic levels were measured in the field with a broad band dipole antenna attached to a portable spectrum analyzer which only offered 30 dB of dynamic range. This was done so the filter characteristics of the radar microstrip antenna would not affect the measurement. The emission bandwidth was measured directly in the lab on a non-portable spectrum analyzer with out an antenna attached. The actual emission bandwidth will be reduced by the bandwidth microstrip antenna but there is not enough dynamic range to measure it with the antenna in place.

8. A 1 x 3 meter antenna is the most commonly used antenna on these wind profilers. Since the application was made, a 2 x 2 electrically steerable antenna has been developed. A few systems will be built with a 3 x 3 electrically steerable antenna. The beamwidths of these configurations are given in the transmitter remarks. Below are the gains of the possible configurations:

1 x 2 meter	gain=23.7 dBi
1 x 3 meter	gain=28.4 dBi

2 x 2 meter gain=26.7 dBi
3 x 3 meter gain=30.2 dBi

Recent antenna measurement by Ball Brothers Research give the gain of a single 1 x 1 meter panel as 19.8 dB so the calculated values above may be slightly high.

I hope this answers the questions. If you have any questions, let me know.